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FIG. 1
(Prior Art)

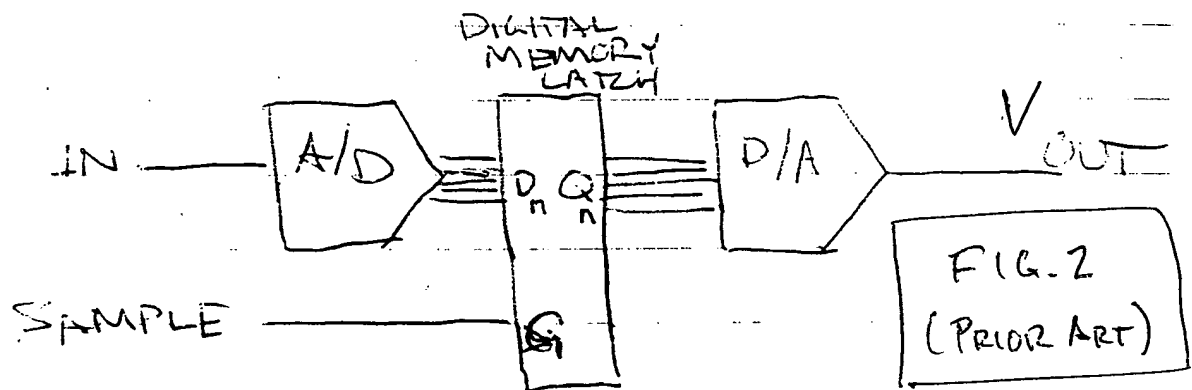
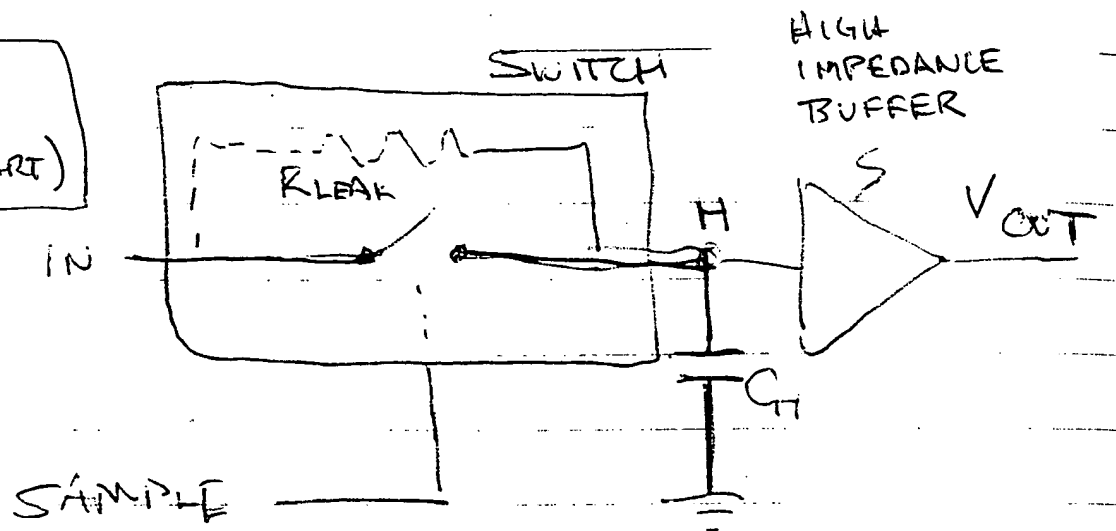
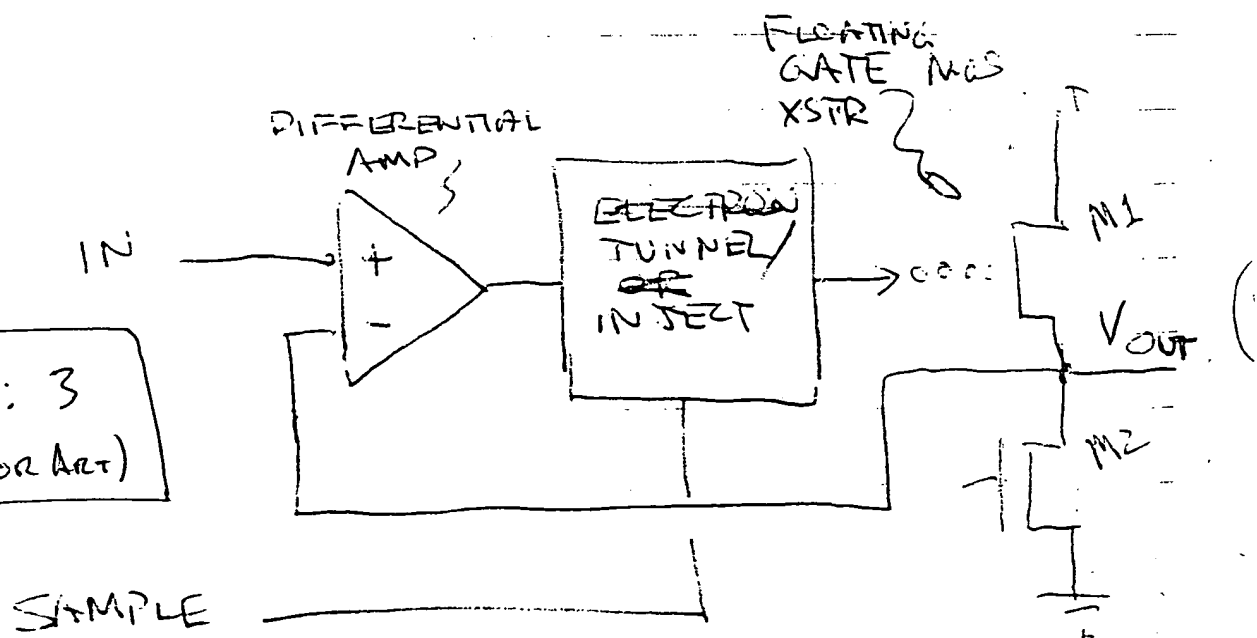


FIG. 3
(Prior Art)



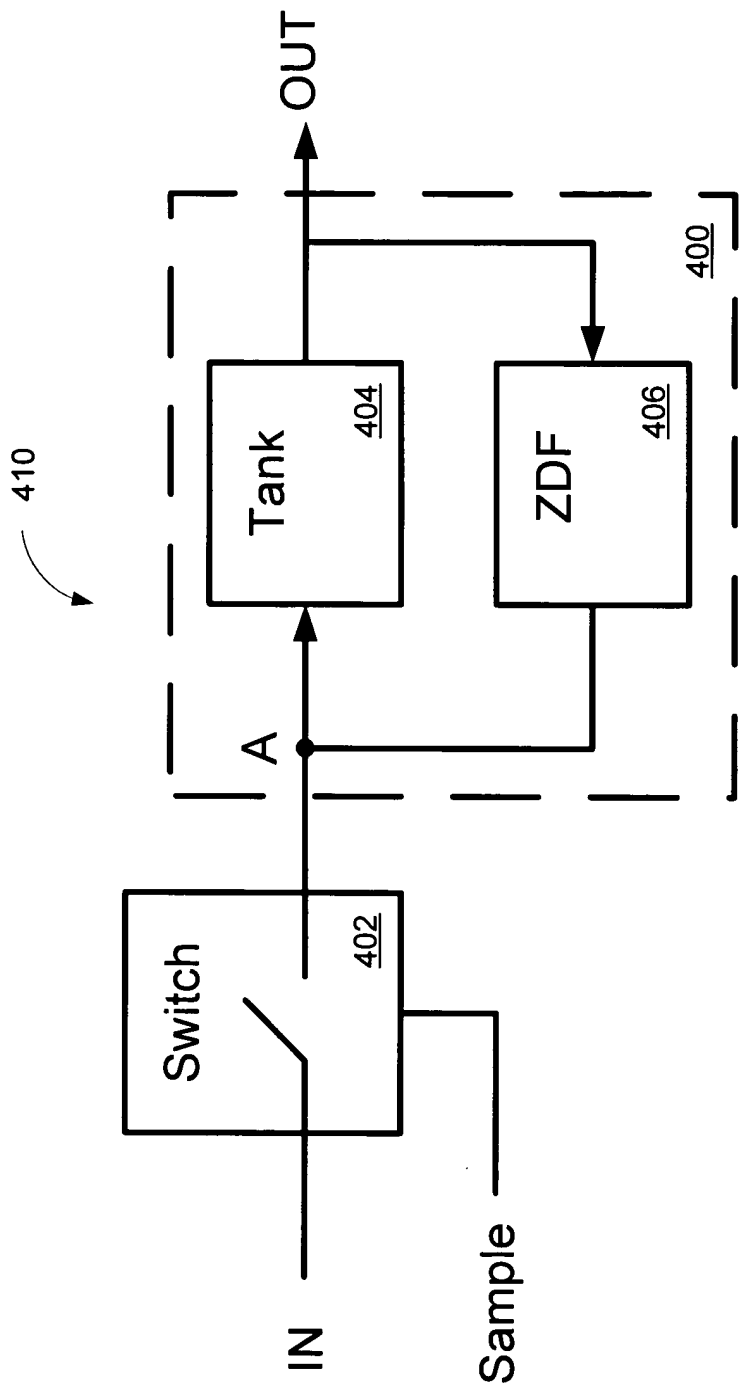
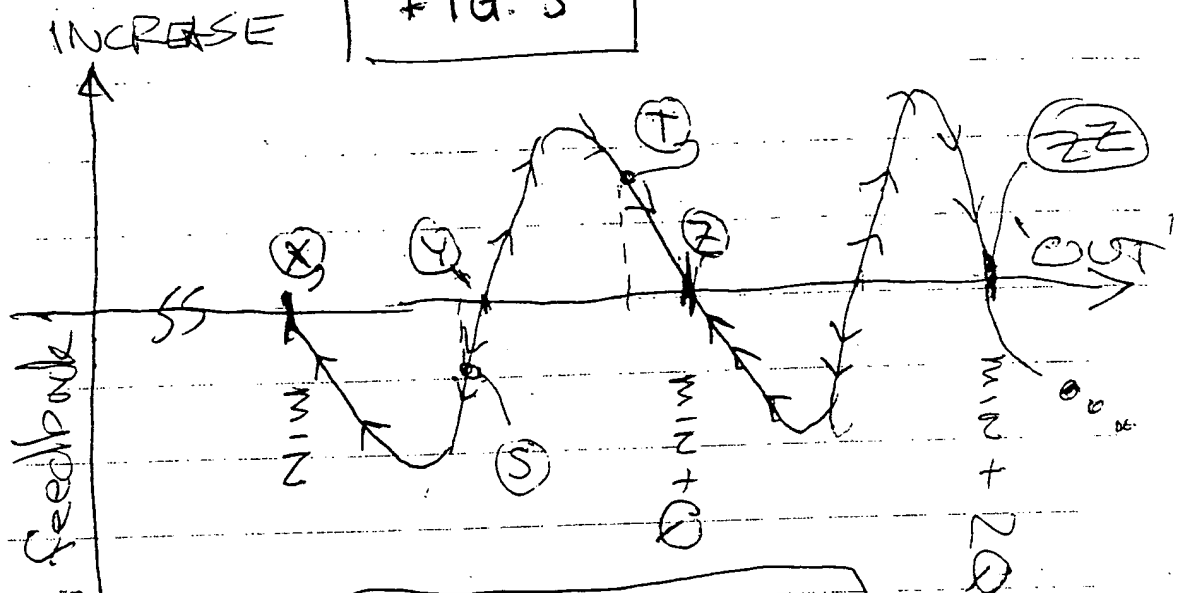


FIG. 4

DETAILS OF 'ZDF' TRANSFER FUNCTION

FIG. 5



DECREASE (X), (Z), are stable

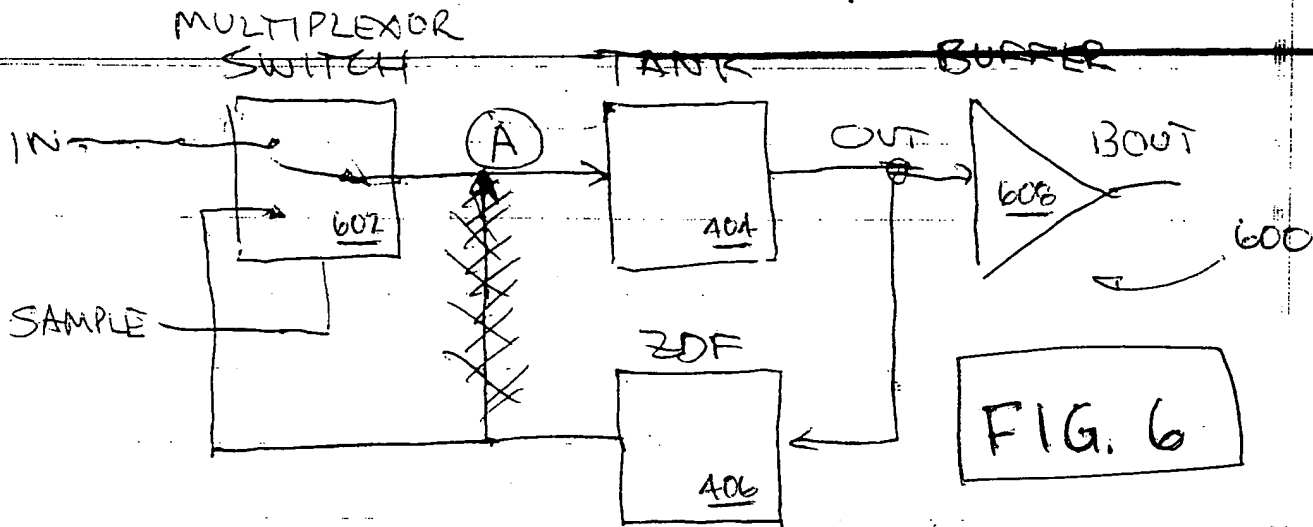
IF OUT IN RANGE (MIN, MIN+Q) THEN FEEDBACK FORCES TO EITHER (X), ie 'MIN' OR (Z) ie 'MIN+Q' AS SHOWN BY ARROWS.

NOTE: PER CONTROL SYSTEM THEORY, DYNAMICS OF TANK AND ZDF MUST BE SELECTED TO ACHIEVE LOOP STABILITY

SLOPE @ POINT (Y) PREFERABLY STEEP TO MOVE QUICKLY AWAY FROM (Y)

(7) 2 APRIL 2003 *[Signature]*

ALTERNATIVES: WITH MUX & BUFFER



USE OF MULTIPLEXOR TO ENSURE THAT

(A) ← 'IN' WHEN 'SAMPLE' AND

(A) ← 'ZDF FEEDBACK' WHEN NOT 'SAMPLE'

ALTR USE OF BUFFER ON OUT PUT TO ENSURE OUTPUT LOAD DOESN'T EFFECT TANK 'OUT'.

EMBODIMENT DETAIL OF ZDF

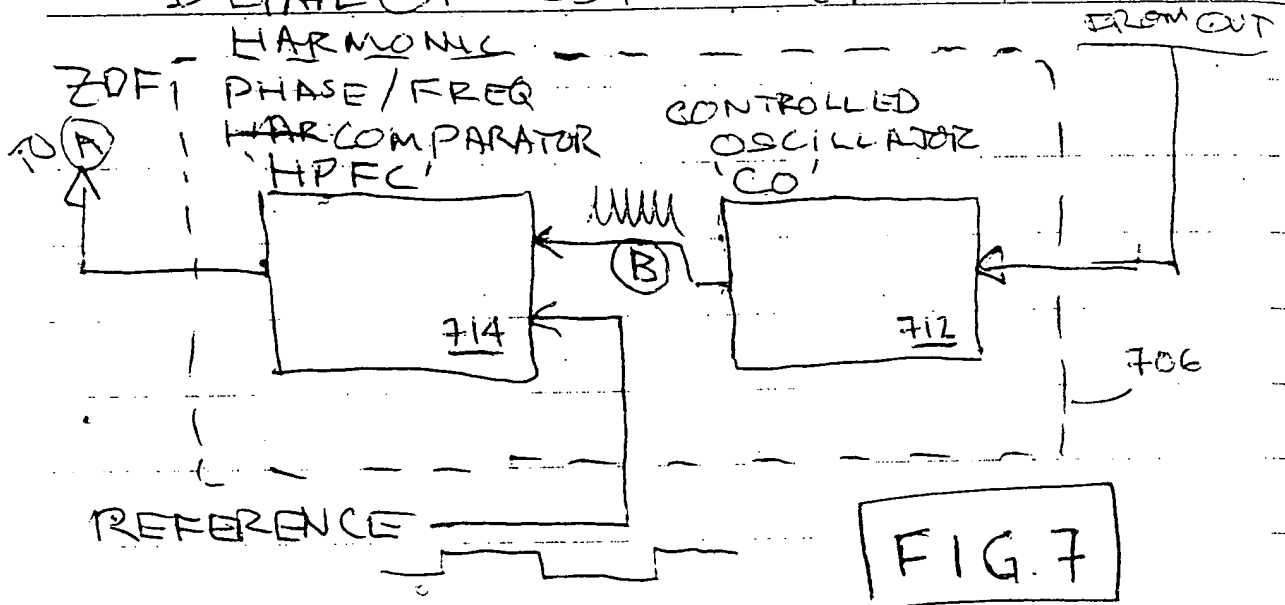
CONTROLLED OSCILLATOR

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DETAIL OF ZDF IN ONE EMBODIMENT



'CO' AND 'HPFC' WELL KNOWN FROM PHASE LOCK LOOPS. 'HPFC' HAS OUTPUT THAT IS FUNCTION OF COMPARISON BETWEEN FREQUENCY / PHASE OF (B) AND ~~AND~~ MULTIPLES OF FREQUENCY ON REFERENCE. THE QUANTIZATION, Q , IS THE 'CO' FREQUENCY RANGE ~~TOTAL~~ DIVIDED BY THE REFERENCE FREQUENCY.

TYPICAL EG

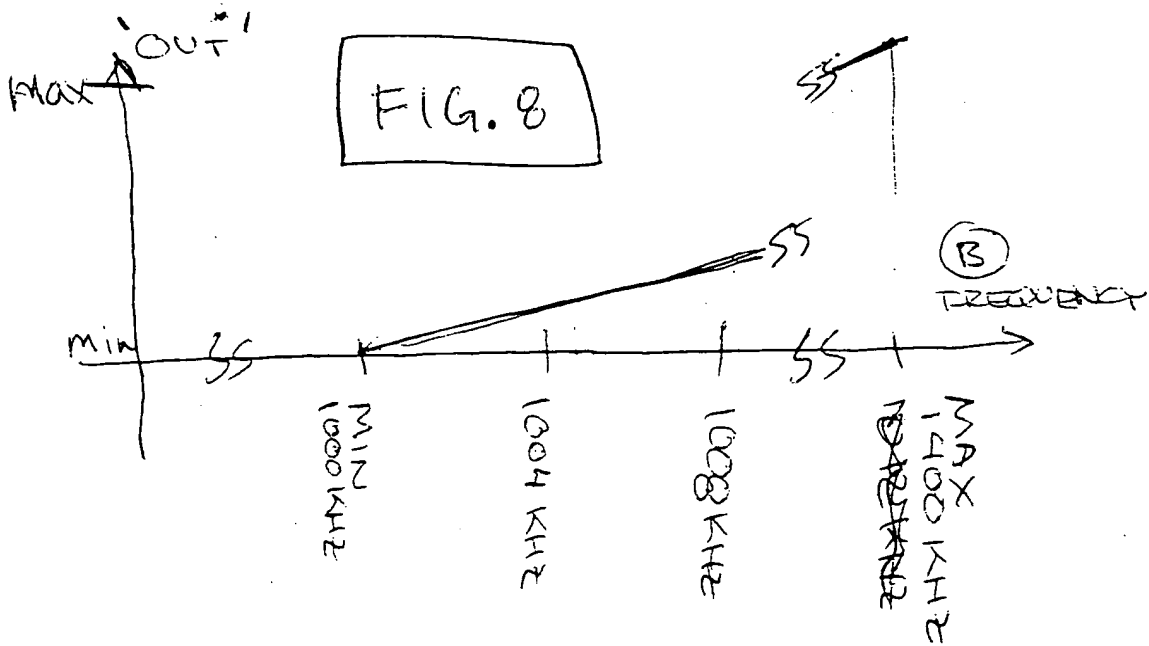
Q \Leftrightarrow 100 : 1 RESOLUTION

'CO' FREQ. MIN = 1000 KHz
MAX = 1400 KHz

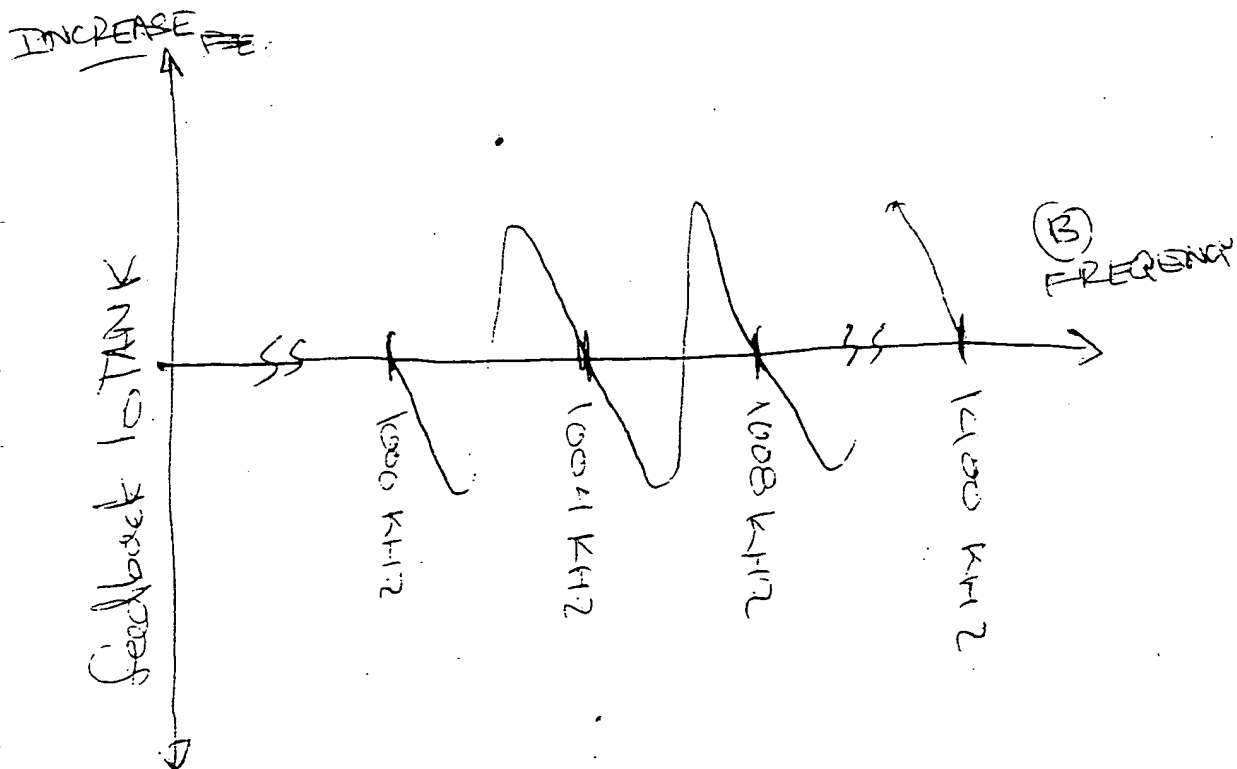
REFERENCE FREQ. = 4KHz

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'CO' FUNCTION



'HPFC' FUNCTION



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10

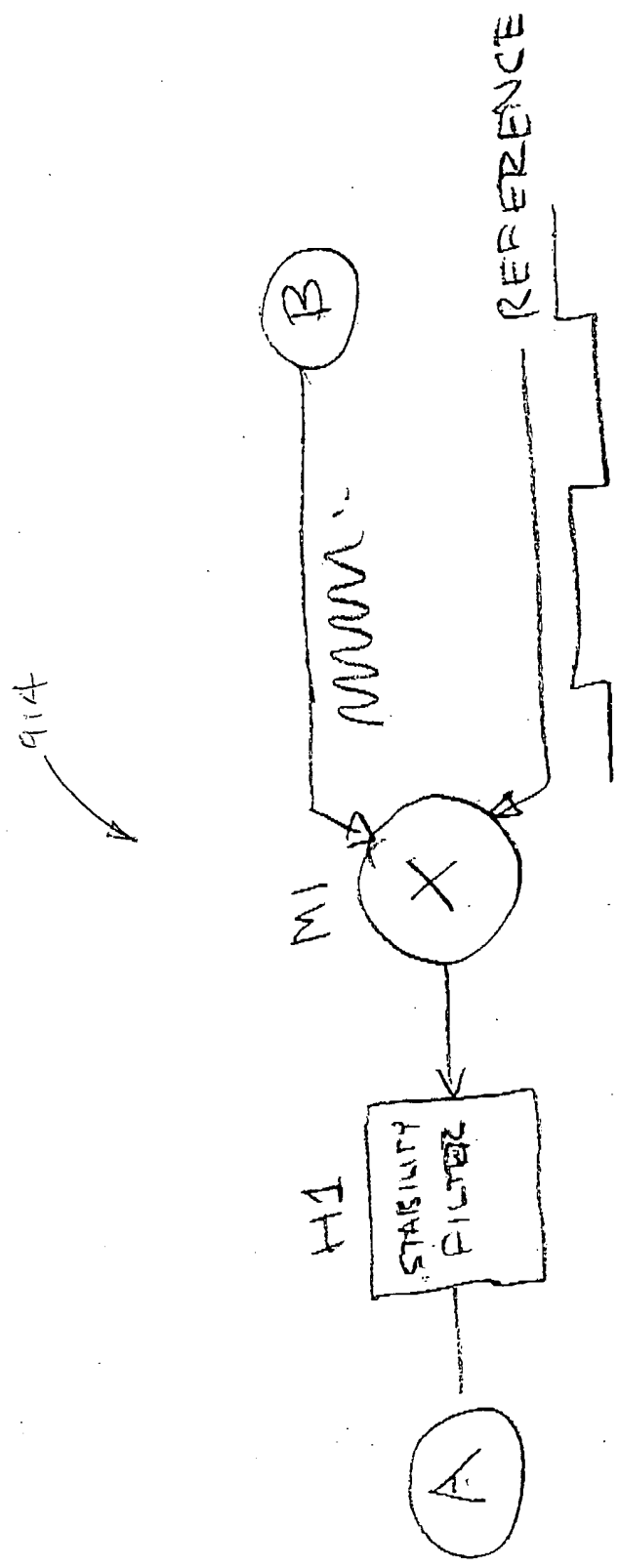


FIG. 9

HPFC

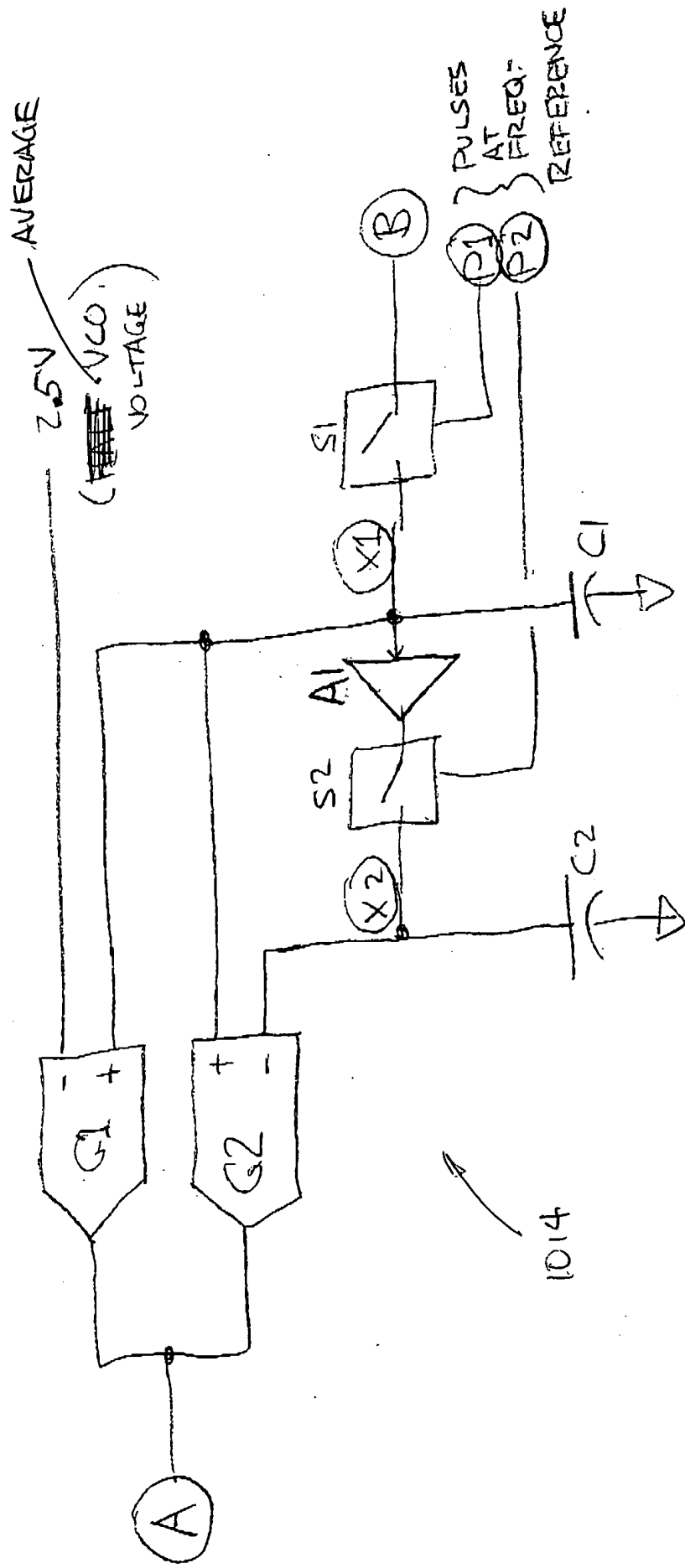
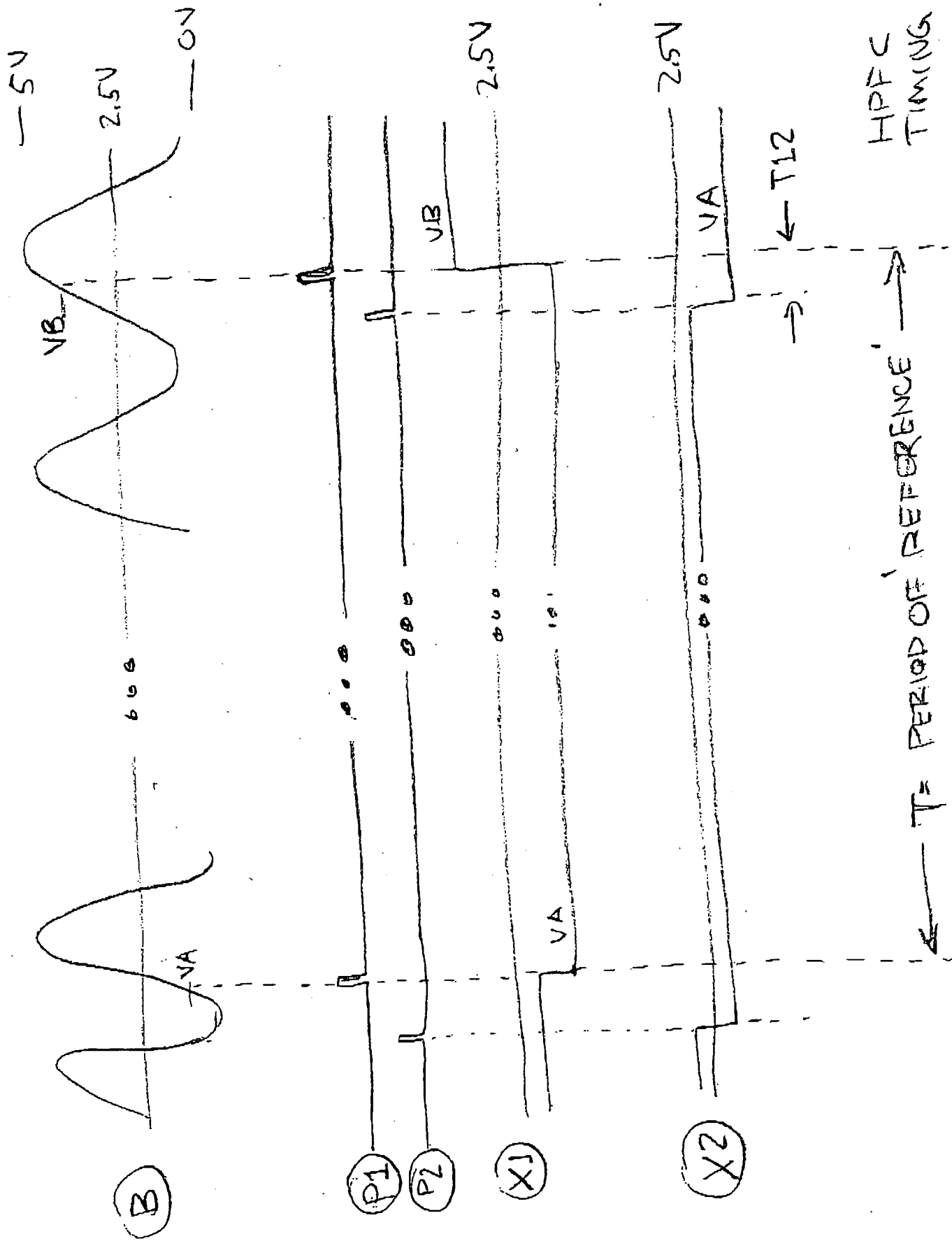


FIG. 10

HPFC

HARMONIC PHASE/FREQUENCY
COMPARATOR



Switched capacitor sampling of sine VCO at frag of REF, and stabilization via a 1-sample delay added in with coeff of typically 50%

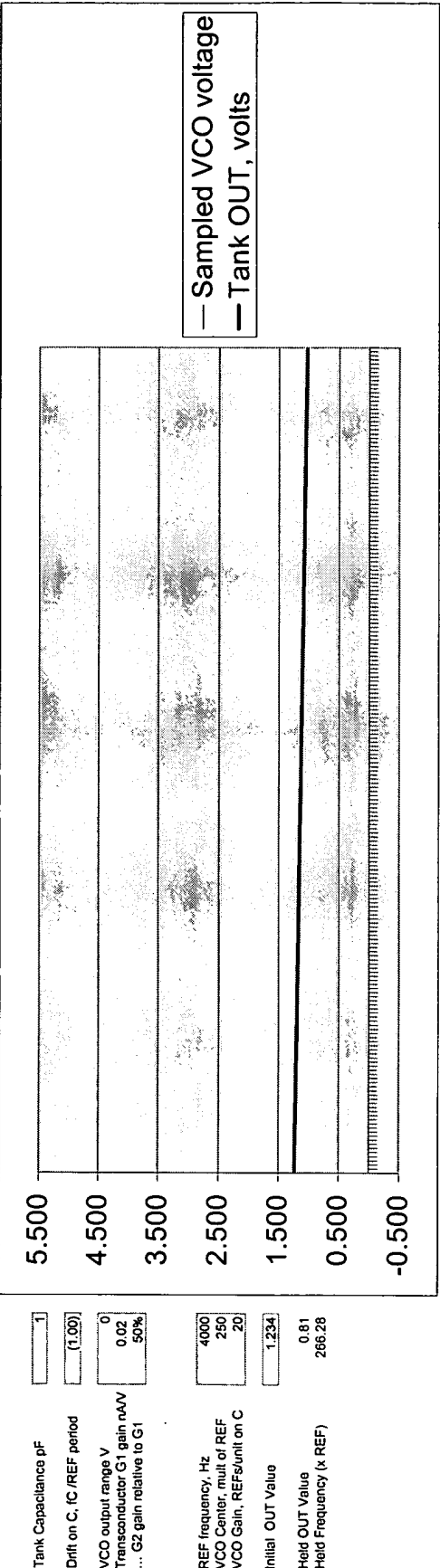


Fig. 12

Switched capacitor sampling of sine VCO at freq of REF, and stabilization via a 1-sample delay added in with coeff of typically 50%

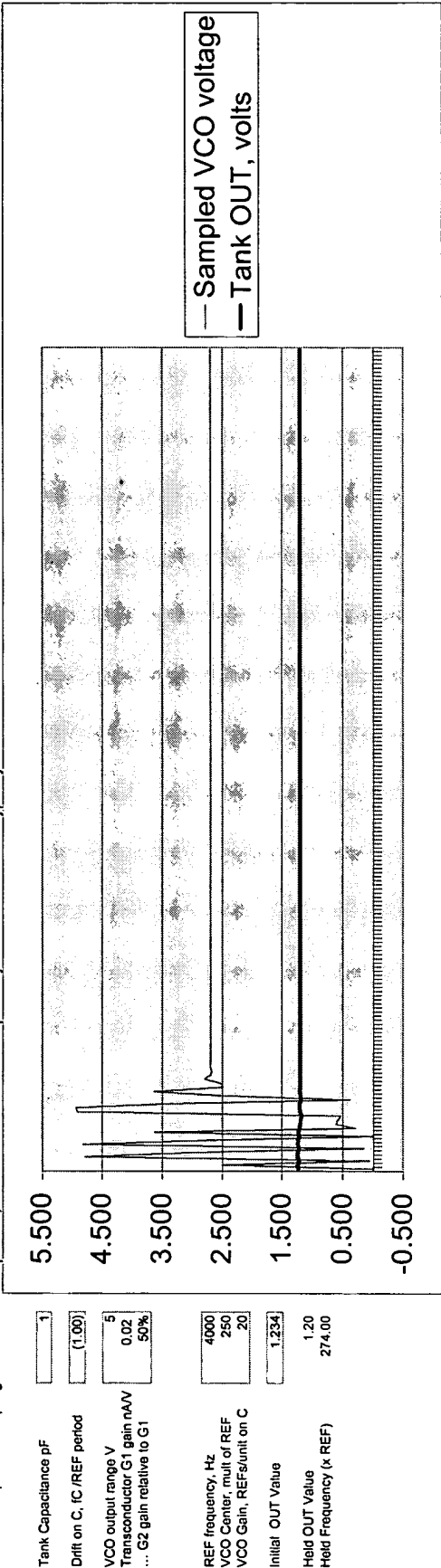
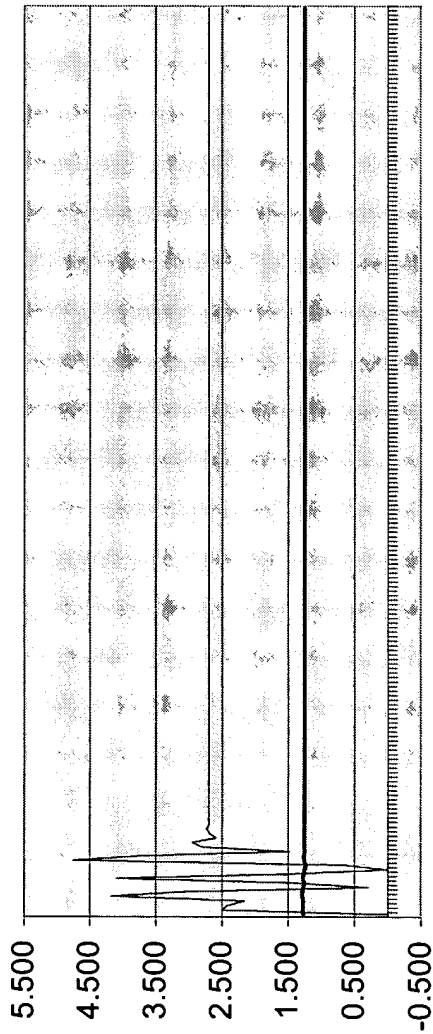


Fig. 13

Switched capacitor sampling of sine VCO at freq of REF, and stabilization via a 1-sample delay added in with coeff of typically 50%

Tank Capacitance pF
Drift on C_{IC} / REF period
VCO output range V
Transconductor G₁ gain nA/V
... G₂ gain relative to G₁
REF frequency, Hz
VCO Center, mult of REF
VCO Gain, REF/unit on C
Initial OUT Value
Held OUT Value
Held Frequency (x REF)



— Sampled VCO voltage
— Tank OUT, volts

FIG. 14